

WHAT IS CLAIMED IS:

1. A method of forming a gel monolith, the method comprising:
preparing a first solution comprising metal alkoxide;
preparing a second solution comprising a catalyst;
preparing a third solution by mixing the first solution and the second solution together;
cooling at least one of the first, second, and third solutions to achieve a mixture temperature for the third solution which is substantially below room temperature, wherein the third solution has a significantly longer gelation time at the mixture temperature as compared to a room temperature gelation time for the third solution; and
allowing the third solution to gel, thereby forming the gel monolith.
2. The method of Claim 1, wherein the metal alkoxide comprises tetramethylorthosilicate (TMOS).
3. The method of Claim 2, wherein the metal alkoxide further comprises tetraethylorthogermanium (TEOG).
4. The method of Claim 1, wherein the metal alkoxide comprises tetraethylorthosilicate (TEOS).
5. The method of Claim 4, wherein the metal alkoxide further comprises tetraethylorthogermanium (TEOG).
6. The method of Claim 1, wherein the first solution further comprises a solvent.
7. The method of Claim 6, wherein the solvent comprises alcohol.
8. The method of Claim 1, wherein the catalyst comprises hydrofluoric acid.
9. The method of Claim 1, wherein the catalyst comprises ammonia.
10. The method of Claim 1, wherein the second solution further comprises water.
11. The method of Claim 1, wherein the second solution further comprises hydrochloric acid.

12. The method of Claim 1, wherein the second solution further comprises a solvent.

13. The method of Claim 1, wherein cooling at least one of the first, second, and third solutions comprises cooling the third solution while mixing the first solution and second solution.

14. The method of Claim 1, wherein cooling at least one of the first, second, and third solutions comprises cooling the third solution after mixing of the first solution and second solution.

15. The method of Claim 1, wherein cooling at least one of the first, second, and third solutions comprises cooling the first solution before mixing the first solution and second solution.

16. The method of Claim 1, wherein cooling at least one of the first, second, and third solutions comprises cooling the second solution before mixing the first solution and second solution.

17. The method of Claim 1, wherein the mixture temperature is approximately equal to or less than zero-degrees Celsius.

18. The method of Claim 1, wherein the mixture temperature is approximately equal to or less than -10 degrees Celsius.

19. The method of Claim 1, wherein the mixture temperature is approximately equal to or less than -25 degrees Celsius.

20. The method of Claim 1, wherein the mixture temperature is approximately equal to or less than -40 degrees Celsius.

21. The method of Claim 1, wherein preparing the first solution comprises cooling the first solution.

22. The method of Claim 1, wherein preparing the first solution comprises mixing the metal alkoxide with a solvent and cooling the first solution.

23. The method of Claim 1, wherein preparing the second solution comprises cooling the second solution.

24. The method of Claim 1, wherein preparing the second solution comprises mixing the catalyst with water and cooling the second solution.

25. The method of Claim 1, wherein preparing the third solution comprises mixing the first solution and the second solution together in a third vessel.

26. The method of Claim 25, wherein the third vessel comprises a static mixer.

27. The method of Claim 25, wherein the third vessel is in an ice bath to cool the third solution.

28. The method of Claim 25, wherein the third vessel is in a refrigerator to cool the third solution.

29. The method of Claim 25, wherein the third vessel is in a glycol bath comprising propylene glycol and water to cool the third solution.

30. The method of Claim 29, wherein the glycol bath is coupled to a chiller.

31. The method of Claim 25, wherein the third vessel is in a glycol bath comprising ethylene glycol and water to cool the third solution.

32. The method of Claim 25, wherein the third vessel is in a freezer to cool the third solution.

33. The method of Claim 25, wherein the third vessel is in a dry ice bath comprising dry ice, propylene glycol, and water to cool the third solution.

34. The method of Claim 25, wherein the third vessel is in a dry ice bath comprising dry ice, ethylene glycol, and water to cool the third solution.

35. The method of Claim 1, wherein cooling the third solution comprises bubbling nitrogen vapor from a liquid nitrogen reservoir through the third solution.

36. A gel monolith formed using the method of Claim 1.

37. A method of processing a solution comprising a catalyst, water, and metal alkoxide, the method comprising extending a gelation time of the solution by keeping the solution at a predetermined temperature substantially below room temperature.

38. The method of Claim 37, wherein the predetermined temperature is approximately equal to or less than zero degrees Celsius.

39. The method of Claim 37, wherein the predetermined temperature is approximately equal to or less than -10 degrees Celsius.

40. The method of Claim 37, wherein the predetermined temperature is approximately equal to or less than -25 degrees Celsius.

41. The method of Claim 37, wherein the predetermined temperature is approximately equal to or less than -40 degrees Celsius.

102 5 42. A solution for a gel monolith, the solution comprising a catalyst with a concentration greater than approximately 3 mole % of the solution.

43. The solution of Claim 42, wherein the concentration of the catalyst is greater than approximately 5 mole % of the solution.

10 44. The solution of Claim 42, wherein the concentration of the catalyst is greater than approximately 10 mole % of the solution.

45. The solution of Claim 42, wherein the catalyst comprises hydrofluoric acid.

46. The solution of Claim 42, wherein the solution has a gelation time greater than approximately five minutes.

15 47. The solution of Claim 42, wherein the solution has a gelation time greater than approximately one hour.

48. The solution of Claim 42, wherein the solution has a gelation time greater than approximately two hours.

20 49. A method of preparing a solution for forming a gel monolith, the method comprising:

providing a first solution comprising metal alkoxide;

providing a second solution comprising a catalyst;

mixing the first solution and the second solution together to form a third solution; and

25 cooling at least one of the first, second, and third solutions to achieve a mixture temperature for the third solution which is substantially below room temperature, wherein the third solution has a significantly longer gelation time at the mixture temperature as compared to a room temperature gelation time for the third solution.

30 50. A monolith comprising:

101
initial mixture
gel

a distribution of pore sizes having a mean pore size and a standard deviation from the mean pore size value, wherein the mean pore size is at least 300 Å and the standard deviation is less than approximately 50 Å.